

Volvulus of the Colon

Incidence and Mortality

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Between 1960 and 1980, 137 patients with colonic volvulus (52% cecal, 3% transverse colon, 2% splenic flexure, and 43% sigmoid) were seen at the Mayo Clinic. Among the 59 patients with sigmoid volvulus, four (7%) had colonic infarction. Total mortality with sigmoid volvulus was seven per cent. There were 71 patients with cecal volvulus. Colonoscopic decompression was accomplished in two of these patients; in 15 (21%), gangrenous colon developed and mortality was 33%. Total mortality for cecal volvulus patients was 17%. Mortality for all forms of volvulus in patients with viable colons was 11%. Mortality for all patients with volvulus was 14%.

VOLVULUS IS A RARE CAUSE of intestinal obstruction in the United States. During the three decades from 1920 to 1950, volvulus caused two per cent of the mechanical obstructions at the Mayo Clinic.¹ Between 1915 and 1946, there were 26 episodes of colonic volvulus at our institution; seven involved the cecum and 17 involved the sigmoid.² Treatment of 12 patients reported in 1948² with cecal volvulus was successful in all cases. Results with sigmoid volvulus were more discouraging: four of 16 patients died. Three of the four who died had had a gangrenous colon at the time of operation.³ In 1947, Bruusgaard⁴ had advocated nonoperative reduction of sigmoid volvulus with the proctoscope and rectal tube.

The purpose of this study was to review our experience with colonic volvulus during the last 20 years. We compared the effect of early nonoperative decompression on the mortality in patients with sigmoid volvulus to the mortality in patients with the other forms of volvulus for which nonoperative techniques of detorsion have not been successful. Because complete medical records are available for the population of Olmsted County during this period, we also calculated the incidence of volvulus.

Methods

Between 1960 and 1980, 137 patients with a diagnosis of colonic volvulus underwent treatment in Olmsted County, Minnesota. These patients fell into two categories: patients residing permanently in Olmsted County, and patients living outside the county who had been referred to the Mayo Clinic. Calculations of incidence were limited to the patients whose domicile was within Olmsted County. For other investigations, all patients treated within Olmsted County but who were not necessarily residents were treated as one group.

The population of Olmsted County is well-suited for studies of the incidence and natural history of colonic volvulus because comprehensive unit medical records for the residents are available. These records are accessible through a central index to the diagnoses made by essentially all medical-care providers used by the local population. This index includes the diagnoses made among outpatients seen in clinic consultations, emergency room visits, or at nursing homes as well as diagnoses recorded among hospital inpatients, at autopsy, or on death certificates. The Rochester epidemiology project for population-based studies has been described previously.⁵

Each patient's chart was reviewed, and complete follow-up was obtained on 136 patients at the time of this study. From each chart, we obtained age, sex, presenting symptoms, history of previous abdominal surgery or previous similar episodes, associated medical illnesses, presenting signs, diagnostic modalities used, therapeutic techniques applied, posttreatment morbidity and mortality, and long-term follow-up.

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TABLE 1. Sites of Colonic Volvulus in Olmsted County Patients and in Total Mayo Clinic Series

Site	Olmsted County		Total Mayo Clinic Series	
	No.	Per cent	No.	Per cent
Cecum	11	41	71	52
Transverse colon	0	0	4	3
Splenic flexure	1	3	3	2
Sigmoid	15	56	59	43
Total	27	100	137	100

Results

During the last 20 years, there had been 27 episodes of colonic volvulus in Olmsted County: 41% cecal, three per cent splenic flexure, and 56% sigmoid (Table 1). The incidences by sites in the Olmsted County series (Table 2) were similar to the distributions in most reported series in the United States, with sigmoid volvulus being the most common locus. The age-adjusted and age- and sex-adjusted incidence based on the 1970 United States white population are also listed in Table 2.

During the same time-period, an additional 110 cases of colonic volvulus were seen at the Mayo Clinic, a referral center within Olmsted County. In the total series of 137 cases of colonic volvulus, the cecum was the most common location (Table 1). The reason for this difference is not clear.

Cecum

The 71 cases of cecal volvulus were divided into two types: 64 (90%) were full proximal colonic volvulus, and seven (10%) were cecal fold volvulus (cecal bascule). The seven patients with cecal fold volvulus included four males and three females ranging from less than 1 to 77 years of age (mean, 51 years; median, 60 years)

TABLE 2. Incidence of Colonic Volvulus in Olmsted County, Minnesota

Group	Cecal		Sigmoid		Colonic	
	No.	Rate, No./10 ⁵	No.	Rate, No./10 ⁵	No.	Rate, No./10 ⁵
≤60 years old	4	0.45	4	0.45	9	1.01
>60 years old	7	5.58	11	8.76	18	14.34
Total	11	1.08	15	1.47	27	2.65
Adjusted*						
Age		1.20		1.67		2.97
Age and sex		1.18		1.66		2.95

* Adjusted to 1970 United States white population.

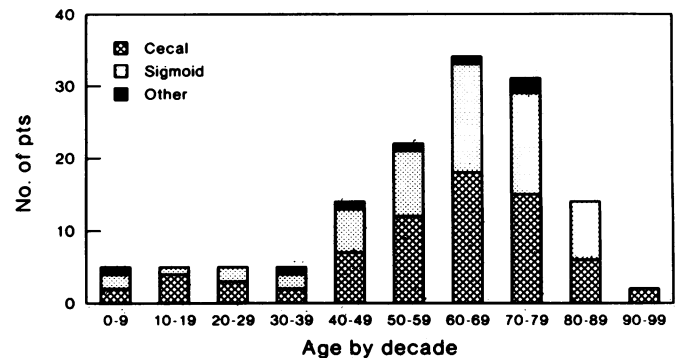


FIG. 1. Age distribution of 137 patients seen at the Mayo Clinic between 1960 and 1980 with volvulus of the cecum, transverse colon, splenic flexure, or sigmoid colon.

(Fig. 1). Of the 64 patients with full cecal volvulus, 38 (59%) were females and 26 (41%) were males; their ages ranged from less than 1 year to 91 years (mean, 59 years; median, 63 years).

Symptoms of colonic obstruction were similar for both forms of cecal volvulus (Table 3). Patients in whom cecal volvulus developed commonly had previous episodes of similar symptoms or had undergone abdominal surgery in the past (Table 4). Of the patients who developed full cecal volvulus, 17 (27%) did so within 2 weeks after other surgical procedures, *e.g.*, orthopedic or urologic procedures. Eighteen (28%) of the patients with full cecal volvulus gave a history of chronic constipation, and seven of these were classified as chronic laxative or enema abusers. Only eight per cent of the patients with full cecal volvulus were institutionalized at the time of their illness. Eighteen (28%) of the 64 patients with full cecal volvulus reported other significant medical problems, including pulmonary disease, diabetes mellitus, and heart disease. Distal obstruction of the colon was found in two patients; a stomach cancer that had spread to involve the splenic flexure caused obstruction in one case, and diverticulitis produced partial distal colonic obstruction in the other.

The methods of diagnosing these episodes of volvulus are summarized in Table 5. The combination of abdominal radiographs and barium enemas clarified the diagnosis in 58% of the patients.

Five patients with cecal volvulus received no operative treatment. The diagnosis was presumptive (clinical) in one patient and was made at autopsy in one. Spontaneous reduction occurred in one patient. She did well, having no recurrence during a 74-month follow-up period. Barium enemas succeeded in reducing the obstruction in two episodes of full cecal volvulus; these patients received no other treatment, and follow-up was not available.

TABLE 3. *Symptoms of Colonic Volvulus*

Symptom	Cecal							
	Fold		Full		Transverse		Sigmoid	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Abdominal distension	6	86	60	94	3	75	52	88
Cramping	6	86	54	84	4	100	50	85
Constipation	3	43	32	50	1	25	43	73
Nausea and vomiting	4	57	33	52	1	25	16	27
Diarrhea	1	14	9	14	0	0	5	8

The results of surgical therapy are listed in Table 6. One patient died on the operating table before any definitive surgical therapy. In the cecal fold group, there were no deaths and no recurrences during follow-ups of 14 months to 15 years (mean, 5.6 years).

Five patients with full cecal volvulus have had no recurrences after detorsion alone for cecal volvulus during follow-ups of 3 months to 12 years (mean, 4.2 years). Of the 27 who survived resection and anastomosis, none have had recurrence during a follow-up of 4 months to 20 years (mean, 5 years). The three survivors of resection and stoma creation have had no gastrointestinal problems during follow-up of 14 months to 14 years (mean, 16.5 years); all three have had bowel continuity restored.

Gangrenous colons were found in 15 patients with cecal volvulus. Eleven (73%) of these patients were febrile at the time of admission and 13 (87%) had leukocytosis. Bowel sounds were diminished in nine (60%) patients. Five (33%) patients with strangulated colons died.

Twelve patients with cecal volvulus died during their hospitalization (Table 7). Whereas mortality for patients with viable colons was only 12%, mortality for patients with gangrenous colons was 33% (5/15). The operative mortality for the 65 patients treated surgically was 15% (10/65). Total mortality for all 71 patients with cecal volvulus between 1960 and 1980 was 17% (12/71).

Transverse Colon

Volvulus of the transverse colon accounted for three per cent of all cases (Table 1). The four cases occurred in three women and one man whose ages ranged from 37 to 76 years (mean, 51 years). Two patients reported having had similar episodes previously. One patient complained of chronic constipation and admitted to laxative abuse. One patient reported previous abdominal surgery. All four of these patients complained of severe,

TABLE 4. *Risk Factors for Colonic Volvulus*

Factor	Cecal					
	Fold		Full		Sigmoid	
	No.	Per cent	No.	Per cent	No.	Per cent
Previous episode	2	29	15	23	26	44
Abdominal surgery	4	57	44	69	31	53
Pregnancy	0	0	1	2	1	2
Institutionalized	0	0	5	8	6	10
Distal obstruction	0	0	2	3	0	0

crampy, abdominal pain on admission to the hospital, and three had abdominal distension. Two patients complained of obstipation, one had nausea and vomiting, and another patient was febrile at the time of admission. Three patients had leukocytosis, and bowel sounds were decreased in two.

The diagnosis of volvulus of the transverse colon was made at operation in all four cases. None of the colons in these patients was strangulated. Three patients underwent operative detorsion without other procedures, and all three of these patients died in the early postoperative period. One patient underwent colopexy; he has done well and has had no recurrence up to the present (77 months of follow-up).

Splenic Flexure

Volvulus of the splenic flexure accounted for two per cent (3/137) of the present cases (Table 1). All three patients were male; one was 1 year old and two were over 70 years of age (mean, 50 years). None of these patients had had previous abdominal surgery. One patient had a history of chronic constipation. All three patients had abdominal distension and obstipation, and one also had nausea and vomiting. The diagnosis was made by

TABLE 5. *Methods of Diagnosing Cecal and Sigmoid Volvulus*

Method	Cecal					
	Fold		Full		Sigmoid	
	No.	Per cent	No.	Per cent	No.	Per cent
Kidney/ureter/bladder radiograph	2	29	25	38	22	37
Barium enema	2	29	13	20	12	20
History	0	0	1	2	4	7
Sigmoidoscopy	0	0	0	0	5	8
Operation	3	43	24	38	13	22
Autopsy	0	0	1	2	3	5

TABLE 6. *Results of Surgical Therapy for Volvulus*

	Operative Detorsion	Cecostomy	Cecopexy	Resection and Primary Anastomosis	Resection and Stoma	Detorsion and Rectal Tube
Cecal fold						
No.	2	1	1	3	—	—
Per cent	30	14	14	43	—	—
Deceased	0	0	0	0	—	—
Recurrence	0	0	0	0	—	—
Cecal, full						
No.	9	3	11	32	4	—
Per cent	16	5	17	55	7	—
Deceased	3	0	1	5	1	—
Recurrence	1	0	0	0	0	—
Sigmoid						
No.	7	—	—	25	10	2
Per cent	16	—	—	56	23	5
Deceased	0	—	—	0	0	1
Recurrence	1	—	—	0	0	1

radiographic contrast studies in one patient and at operation in two.

The patient whose diagnosis was established by barium enema refused operation and was lost to follow-up. The remaining two patients underwent resection and stoma creation and did well after surgery. Follow-up was not available on one of these patients. The second patient has been followed for more than 5 years and has had no recurrence (bowel continuity was restored).

Sigmoid

Fifty-nine patients—27 males (46%) and 32 females (54%)—had sigmoid volvulus (Table 1). Their ages ranged from 2 to 94 years (mean, 61 years; median, 64 years). The presenting symptoms are listed in Table 3. Twenty-six of the 59 patients (44%) with sigmoid volvulus gave a history of similar episodes in the past that resolved spontaneously; 31 patients (53%) gave a history of previous abdominal surgery. None of the patients was psychotic; the six patients (10%) who were institutionalized were from nursing homes and convents. Only

one patient with sigmoid volvulus was pregnant (third trimester). Twenty-eight patients (47%) had other significant medical problems.

Plain abdominal radiographs (Table 5) were diagnostic for sigmoid volvulus in 22 (37%) of our 59 patients. Barium enema revealed sigmoid volvulus in an additional 12 patients (20%). Thus, radiography demonstrated sigmoid volvulus in 57% of these 59 patients.

Sigmoidoscopic reduction was successful in 26 (84%) of 31 attempts. Eight of these patients received no further treatment. Four were immediately operated on because gangrenous changes were noted on sigmoidoscopy; these four underwent resection and stoma creation. Fourteen other patients underwent bowel preparation and elective sigmoid resection.

Of the eight patients who had sigmoidoscopic reduction only, six have had no recurrence during follow-up periods of 4 months to 15 years (mean, 49 months). One patient had a definite recurrence of sigmoid volvulus 31 days after the sigmoidoscopic reduction and underwent resection and anastomosis at that time.

Operative treatment of sigmoid volvulus is summarized in Table 6. Of the 25 undergoing resection with primary anastomosis, 14 had had prior endoscopic reduction of an acute volvulus and 11 had chronic sigmoid volvulus; all had bowel preparation. In the 35 cases involving resection, there was no mortality and no recurrence, whereas operative treatment without resection in nine patients resulted in one surgical death (11%) and two recurrences (22%).

All four of the patients who had gangrenous changes of the sigmoid had fever and leukocytosis on admission. Three of these four had no bowel sounds on admission. All four underwent resection and creation of a stoma, and none died.

TABLE 7. *Mortality From Colonic Volvulus*

Site	Colon Viable		Colon Necrotic		All Patients	
	No.	Per cent	No.	Per cent	No.	Per cent
Cecum	7	12	5	33	12	17
Transverse colon	3	75	0	0	3	75
Splenic flexure	0	0	0	0	0	0
Sigmoid	4	7	0	0	4	7
Total	14	11	5	26	19	14

Four patients died during the index admission (Table 7). Three patients died prior to any surgical treatment and the diagnosis was made at autopsy. One patient died shortly after operative decompression and stenting with a rectal tube. The operative mortality for patients with sigmoid volvulus was two per cent (1/44). Total mortality for all patients with sigmoid volvulus between 1960 and 1980 in Olmsted County and the Mayo Clinic was 7 per cent (4/59).

Discussion

Incidence of Volvulus

Volvulus is a rare form of intestinal obstruction in Minnesota. In a series of 100 consecutive intestinal obstructions reported from the Mayo Clinic in 1958 (Table 8), volvulus was the cause in only seven cases.¹ In the University of Minnesota series of 1252 cases of intestinal obstruction, volvulus was the cause in only 42 (3.4%).⁶ This low incidence has been found in other areas around the world. However, volvulus is the most common cause of intestinal obstruction in other regions, *e.g.*, parts of Iran and Russia. Many factors come into play in determining the local incidence of volvulus.

In our study, cecal and sigmoid volvulus had the same incidences among patients less than 60 years of age (Table 2). It is in the patients older than 60 that the incidence of sigmoid volvulus is greater than that of cecal volvulus. In these older patients, an acquired redundant sigmoid colon, so important in the pathogenesis of sigmoid volvulus, develops in the United States population. In the younger patients, anomalous fixation of the colon may be the more important factor in volvulus development, explaining the similar incidences at the two sites.

The proportions of various forms of volvulus in the Olmsted County group of patients are similar to those in other American series. In a collected series of 546 episodes of volvulus, the locations were: cecum, 34.5%; transverse colon, 3.6%; splenic flexure, 1%; and sigmoid colon, 60.9%.¹⁶ The preponderance of sigmoid volvulus is even more evident in the world literature. In a collected worldwide series of 1845 episodes of colonic volvulus, sigmoid volvulus accounted for 76.2%.¹⁷ Our total series differs from this pattern: cecal volvulus represented 52%, probably reflecting the bias found in data from a referral center population.

Cecal Volvulus

A mobile cecum is a prerequisite for cecal volvulus. Various anomalous patterns of cecal fixation allow cecal mobility. Examination of 125 cadavers at Northwestern

TABLE 8. *Percentages of Reported Intestinal Obstructions Produced by Volvulus*

Place	Year	No. of Cases	Percentage Caused by Volvulus
Mayo Clinic ¹	1958	100	7.0
Minneapolis ⁶	1955	1252	3.4
New Orleans ⁷	1950	258	20.0
New York ⁸	1900	1000	1.2
England ⁹	1872	730	1.6
England ¹⁰	1932	6892	2.6
Nigeria ¹¹	1965	436	4.4
Rhodesia ¹²	1961	130	11.6
Sudan ¹³	1976	138	16.7
Iran ¹⁴	1969	286	42.0
Russia ¹⁵	1925	245	54.6

University Medical School revealed that 11.2% of the right colons were freely mobile with complete common ileocolonic mesenterium.¹⁸ In an additional 25.6% of the cadavers, the cecum was sufficiently mobile to permit a fold. Thus, 36.8% of the cecums were mobile enough for volvulus to occur.

Despite the similar distribution of these anomalous cecal fixations in other international studies,¹⁸⁻²⁰ the incidence of cecal volvulus varies widely in different regions. Other factors must also be involved.

Various risk factors have been implicated in the cause of cecal volvulus. The high incidence of cecal volvulus among Eastern European peasants has been attributed to their coarse high-fiber diet.²¹ Jordan and Behrs²² reported six episodes of cecal volvulus in the early postoperative period. They thought that the withdrawal of abdominal packs or undue manipulation of the ileocecal region might precipitate volvulus after operation. Wertkin and Aufses²³ noted a high incidence of previous abdominal operations in patients with cecal volvulus. Among our patients, 48 (68%) of the 71 patients had undergone previous abdominal operations. Grover et al.²⁴ suggested that increased peristalsis caused by diarrhea or violent purging might predispose to volvulus. Distension caused by obstruction also has been indicted.²⁵ Pregnancy or pelvic tumors or cysts that push the cecum out of the pelvis have been cited as predisposing factors.²⁶ The present series includes many patients with some of these risk factors (Table 4). Forty-eight of the cecal volvulus patients had undergone previous abdominal operations. Two patients also had distal obstructions. One patient was pregnant.

Abdominal radiographs often can detect cecal volvulus. The point of the "coffee bean" deformity in cecal volvulus is directed toward the left upper quadrant (Fig. 2), in contrast to the "bent inner tube" of sigmoid volvulus (Fig. 3), in which the point is usually directed

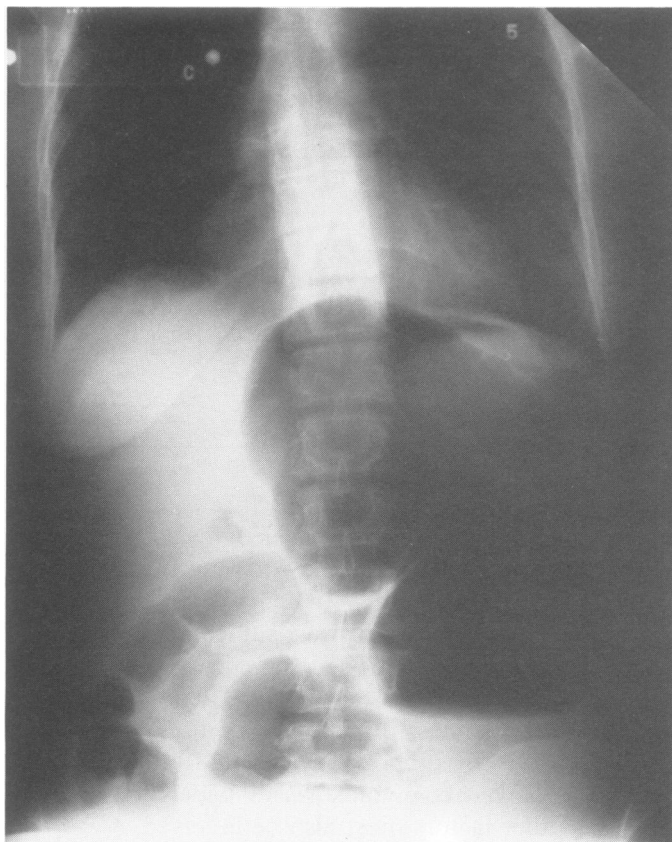


FIG. 2. Point of the "coffee bean deformity" in cecal volvulus is directed toward the left upper quadrant.

toward the right. In some series, abdominal films have provided the diagnosis in more than 50% of patients with cecal volvulus.²⁷ In our series, radiographic diagnosis was made in 27 (38%) of the 71 patients with cecal volvulus (Table 5). Abdominal radiography plays a critical role in the early evaluation of patients suspected of having volvulus.

The need for barium enemas in patients with acute colonic obstruction from volvulus is debatable. At the Mayo Clinic, barium enema diagnosed cecal volvulus in 15 cases (21%). Ellis²⁶ thought that such studies needlessly delay necessary surgical treatment. Smith and Goodwin,²⁷ on the other hand, were able to make the diagnosis of cecal volvulus in 22 of 24 patients with barium enemas. Barium enema can be helpful for detecting cecal volvulus in difficult cases but should not be performed routinely when the diagnosis of cecal volvulus is clear.

Nonoperative modalities for reducing cecal volvulus are few and little-tested. Colonoscopic reduction of cecal volvulus was attempted in four patients at the Mayo Clinic,²⁸ and reduction was accomplished in one. This therapeutic modality represents our greatest hope for

successful nonoperative reduction of cecal volvulus in the future. During the early period of resuscitation before operative intervention is feasible, colonoscopic reduction of cecal volvulus may be attempted by an accomplished endoscopist.

In general, once the diagnosis of cecal volvulus has been made, operative intervention should be undertaken. When the cecum is gangrenous, all agree that resection is mandatory. In this series, the 15 patients with gangrenous colons all underwent resection. When the cecum is viable, several different procedures are available, including cecopexy, cecostomy, and resection (Table 6).

Operative detorsion without fixation may relieve cecal distension temporarily in patients with cecal volvulus, but does not attack the underlying predisposing problems. A high rate of recurrence (1/9) and death (3/9) followed this operation in the nine such cases in our series. This technique should not be performed.



FIG. 3. The point of the "bent inner tube" feature of the sigmoid volvulus usually is aimed toward the right upper quadrant.

Cecopexy, by anchoring the right colon to the parietal peritoneum, treats cecal volvulus by eliminating prerequisite hypermobility. The operative field remains uncontaminated during this procedure because the bowel is not opened. Cecopexy was performed on 11 patients in this series. There was one death and no recurrence. This operation has been advocated recently by O'Mara's group.²⁹ During a 22-year period at Johns Hopkins, 50 patients were treated for cecal volvulus. No deaths or recurrences occurred in the 18 patients who underwent cecopexy. Results in other reports have not been this favorable. Todd and Forde³⁰ noted eight recurrences following 28 cecopexies in seven published series—a 28.6% recurrence rate. Fixation of the cecum that is adequate for preventing future volvulus can be difficult to obtain.

Cecal volvulus produces colonic obstruction. Distension can cause necrosis of the bowel wall. Simple detorsion sometimes allows decompression into the distal colon, but often it does not. Cecostomy accomplishes both cecal fixation, like cecopexy, and intestinal venting. Previously at the Mayo Clinic, appendicostomy was used to accomplish fixation and decompression.²² More recently, cecostomy has been preferred. No deaths or recurrences have followed this procedure. In reviewing seven series of cecal volvulus, Todd and Forde³⁰ found no recurrences after 31 cecostomies. Decompression and fixation of the cecum can be accomplished well with cecostomy.

Right hemicolectomy precludes any possibility of recurrent volvulus. Resection was performed in 22 patients with viable colons at this institution since 1960; one operative death occurred in this group. Meyers et al.³¹ advocated primary resection whenever feasible in patients with cecal volvulus. When there are areas of necrosis or impending perforation, resection is necessary. Primary anastomosis can be performed in selected patients but, in others, the anastomosis might be best delayed to a second procedure.

Mortality from volvulus is high in patients with gangrenous bowel. It was 33% in our patients with gangrenous cecums, representing nearly half of our total mortality (Table 7). In a collected series, 41.4% of 29 patients with necrotic bowel from cecal volvulus died.³⁰ In contrast, patients with viable colons at the time of operation fared better. Only 12% of our 56 such patients died. There was a 14.5% death rate in 117 patients with viable bowel in Todd and Forde's collected series.³⁰ Mortality in patients with cecal volvulus can be kept near 10% if operative intervention is accomplished before cecal strangulation. Once the cecum has become gangrenous, a death rate of 30 to 40% can be expected.

Transverse Colon Volvulus

Only 66 cases with volvulus of the transverse colon as a cause of intestinal obstruction have been reported in the world's literature.³² In a compiled series of 524 American cases of volvulus, 19 (3.6%) were of the transverse colon,¹⁶ and it represented only 1.9% of the 1845 cases in a compiled series of international reports.¹⁷ Patients tend to be middle aged (mean, 51 years in this study). Women outnumber men two to one.³² The signs and symptoms are typical of large bowel obstruction. A history of previous surgery is common in these patients. Diagnosis by abdominal radiography is difficult. The diagnosis of transverse colon volvulus was not suspected in any of our four patients before operation. No distinct features separate the clinical picture of transverse colon volvulus from that of cecal volvulus.

Nonoperative attempts at reducing volvulus of the transverse colon have not been reported. Treatment requires surgical intervention. The principles of treatment are identical to those for cecal volvulus. If necrotic colon is found at operation, resection is mandatory. Because hypermobility of the transverse colon is necessary for volvulus to occur, the goal of surgical therapy should be fixation. Mortality has been high after simple detorsion. In this series, all three patients treated by this manner died, in spite of the fact that all had viable colons. The one patient who underwent a colopexy has done well without evidence of recurrence. Good results with a transverse tube colostomy were reported by Slotkin.³³ Some surgeons have recommended resection as the procedure of choice in all patients.³² Transverse colectomy can be undertaken but may not be necessary for satisfactory results in patients with viable colons.

Splenic Flexure Volvulus

The splenic flexure of the colon is the least common site of volvulus. Twenty cases, including the three cases here, have been reported.¹⁶ In published American series of colonic volvulus, splenic flexure volvulus represents about one per cent.¹⁶ Only one case occurred in our Olmsted County population, an incidence of three per cent (Table 1). The three patients in the total series accounted for two per cent of the total. In an international collection of 810 cases of volvulus, no episodes of splenic flexure volvulus were listed outside the United States.³⁴

The splenic flexure is fixed in position by three attachments: the gastrocolic, phrenocolic, and splenocolic ligaments. Congenital absence of any of these ligaments or injury to them during abdominal surgery predispose the patient to volvulus. Complete absence of all three ligaments was reported in two patients.^{35,36} Agnesis of

one of these structures has also been found in two patients.^{37,38} About two-thirds of the patients in whom splenic flexure volvulus has occurred had previously undergone abdominal surgery. Anomalous splenic flexure fixation or a history of abdominal surgery was not found in any of our patients.

Treatment of this condition requires fixation or resection of the splenic flexure. Colopexy of the splenic flexure has not been reported. Ballantyne¹⁶ successfully treated one patient with a splenic flexure colostomy which provided decompression and fixation. Eight patients, including two of ours, have undergone resection. Results from both techniques have been excellent.

Sigmoid Volvulus

In the United States, the factors that predispose to volvulus in adults are largely acquired. This is in contrast to cecal volvulus. Von Rokitsky pointed out 135 years ago that the main predisposing factor was a "congenital or acquired long, loose, and floppy mesentery."³⁹ In his book Treves wrote that, in sigmoid volvulus, "The loop must be of considerable length, the meso-colon must be long and very narrow at its parietal attachment, so that two ends of the loop may be brought as close together as possible."⁴⁰

In the United States, sigmoid volvulus is found most frequently in elderly, institutionalized, or chronically constipated persons.¹⁷ The average age of 99 patients at Charity Hospital in New Orleans in whom sigmoid volvulus developed was 66.⁴¹ This is similar to the average in our series, 61 years. Thirteen of the patients at Charity Hospital were admitted from nursing homes, as were six of ours. Sigmoid volvulus has been seen in many patients institutionalized for neuropsychiatric disorders.^{42,43} These studies have suggested that residents of chronic-care facilities often suffer from chronic constipation. In addition, many of the psychotropic drugs they receive affect bowel motility adversely.

Other etiologic factors have been noted in different regions of the world. The high incidence of sigmoid volvulus in areas such as Russia,⁴⁴ India,⁴⁵ Iran,¹⁴ Norway,³ and Africa¹³ has been attributed to the high-fiber vegetable diet of the people.

Specific conditions can make the colons more susceptible to sigmoid volvulus. Chagas' disease in Brazil causes megacolon, and 30% of 365 patients with this disease in São Paulo had volvulus of the sigmoid colon.⁴⁶ The most common cause of intestinal obstruction in pregnant American women is sigmoid volvulus; 44% of 182 obstructions reported in ten series of pregnant women were caused by sigmoid volvulus.¹⁷

Adhesions from previous abdominal operations oc-

asionally have been implicated in the genesis of sigmoid volvulus.^{47,48} Among our patients, 53% had undergone previous abdominal procedures (Table 4).

Radiographic techniques are particularly useful for revealing sigmoid volvulus. The "ace of spades" or "bent inner tube" arising from the left lower quadrant clearly identifies sigmoid volvulus. Abdominal radiographs identified sigmoid volvulus in 37% of the patients in the present series (Table 5) and in 42 of 45 patients at Northwestern Memorial Hospital.⁴⁹ At Charity Hospital, abdominal radiographs were diagnostic in 61.5% of cases.⁴¹

During the first 50 years of this century, the therapeutic approach to sigmoid volvulus was early surgical exploration. Moynihan stated in 1905 that any mortality greater than 10% was the "mortality of delay" in undertaking operative intervention.⁵⁰ In 1947, Bruusgaard⁴ challenged this strategy. He reported a success rate of 86% after nonoperative reduction (proctoscope and rectal tube) of sigmoid volvulus. The mortality rate was 14.2%. Since that time, many reports have confirmed the accessibility of sigmoid volvulus to nonoperative detorsion by this technique. At the Mayo Clinic, 26 (84%) of 31 proctoscopic examinations relieved the obstruction. At Charity Hospital, use of the rectal tube and proctoscope achieved reduction in 92 (77%) of 119 attempts.⁴¹ Drapanas and Stewart⁵¹ reported 84% success. Whenever sigmoid volvulus is suspected, sigmoidoscopy and passage of a rectal tube should be attempted. Proctoscopic reduction is the technique primarily responsible for decreasing the mortality of sigmoid volvulus to less than 10% at the Mayo Clinic.

Other nonoperative techniques for achieving reduction have not been as successful. A regular or barium enema accomplished detorsion in three per cent or 5.4%, respectively, of 596 patients in a compiled series.³⁴ Spontaneous reductions can be expected in about two per cent of patients. Recently, the colonoscope has been used in reducing sigmoid volvulus. Only small series of cases treated with this instrument have been published,^{52,53} but it seems to be a promising approach. For now, its use should be limited to patients in whom rigid scopes have been unsuccessful in reaching the closed loop obstruction.

Nonoperative reduction of sigmoid volvulus does not constitute adequate treatment. It is a temporizing measure that allows implementation of definitive operative therapy under improved circumstances. The high rate of recurrence and high mortality rate associated with nonoperative reduction have been well-documented. At Northwestern University, 90% of patients treated with nonoperative reduction had recurrences.⁴⁹ At San Bernardino, California, there were six early recurrences and

three late ones after 14 nonoperative detorsions.⁵⁴ Ten per cent of patients having recurrence of the volvulus have died.³⁴ Nonoperative reduction of sigmoid volvulus succeeds in decompressing the obstructed bowel but does not succeed in preventing future episodes.

Conclusion

The best operative therapy for sigmoid volvulus is resection. The recurrence rate after operative detorsion without other treatment is 18.2%.³⁴ Two of nine patients in our series had another volvulus (22%). Other modalities such as sigmoidopexy, tube sigmoid colostomy, or mesocoloplasty have been suggested but have only been performed in a few patients. Sigmoid resection has been generally selected as the procedure of choice. Arguments have persisted about the need for two- or three-stage procedures. In this series, bowel preparation followed by resection with primary anastomosis was accomplished in 56% of the patients (Table 6). The principal strategy for treating sigmoid volvulus is early nonoperative detorsion followed by elective surgery on a well-hydrated patient with prepared bowel.

As predicted by Moynihan⁵⁰ 80 years ago, the major cause of mortality in sigmoid volvulus is delay in decompressing the ischemic bowel. Mortality was 80% for patients with gangrenous colons compared to 10.6% for patients with viable colons in a combined series of 299 American patients.³⁴ The low mortality (7%) with sigmoid volvulus at the Mayo Clinic can be attributed primarily to the low percentage of patients with necrotic colons (7%). Early reduction of the volvulus by nonoperative techniques coupled with operation on patients with prepared bowels produces mortality rates below the 10% limit mentioned by Moynihan.⁵⁰

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